

Appendix B. Color Tables and Scale Colorbars

When rendering a plot from an array of data, Panoply uses color table information to translate the data values into colors. A scale indicating the relation between colors and data values is rendered on the plot as a “color-bar”.

The color information is stored in separate files, which may be called “color look-up tables” or just “color tables”. Two of these, `grayscale.act` and `panoply.gct`, are bundled into the Panoply application itself, and more than 50 others are included in the distribution directory called `colorbars`. When launched, Panoply will automatically load all of the color tables in that directory.

If there are color tables in the `colorbars` directory which you don’t need, you can simply remove them, and the next time Panoply is launched they won’t be included in plot options. Conversely, if you have favorite color table files which are not part of the Panoply distribution, you can add them to the directory and they will be automatically opened, provided that they are in a recognized format. You can also use the Open... item in the File menu to open color tables located elsewhere on your computer.

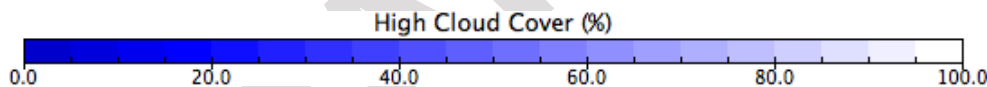
There are seven types of color table files that Panoply recognizes and which you can identify by the filename extension: `.act`, `.cpt`, `.cwc`, `.gct`, `.gpl`, `.pal`, and `.pal`. Most of the sample color table files included in the Panoply distribution are either `.act` or `.cpt` files.

To browse all of the color tables that Panoply has opened and which you can use in your plots, select the Color Tables Browser item in the Window menu.

B.1. Color Table “Bins”

Each type of color table is treated by Panoply as being composed of a number of “bins”, or indices in an array of colors (i.e., a look-up table), and each data value in a plot is assigned an appropriate index according to its relation to the specified minimum and maximum values of the scale’s range. Each bin is assumed to represent an equal-sized portion of the color scale.

For example, assume we have a plot whose scale has a minimum value of 0.0 and a maximum value of 100.0, as shown in Fig. B.1.



Further, a color table has been applied which defines 20 colors. Figure B.2 shows how this particular color table appears when displayed in the Color Tables Browser window, as a colorbar above and as a collection of 20 bins below.

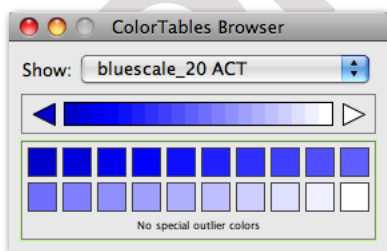


Figure B.2

In this example, all data values from 0.0 to 5.0 are assigned the first color (dark blue) in the table, values from 5.0 to 10.0 are assigned the second color, and so on until values from 95.0 to 100.0 are assigned the 20th color (white).

But what happens in this case if you had data with values less than 0.0 or greater than 100.0? Panoply will assign to all values less than the scale minimum the first color in the table. Data values greater than the scale

maximum are assigned the last color. In Fig. B.2, these “out of range” or “outlying” values are shown in the triangular outliers of the colorbar.

(There are two exceptions to this handling of out-of-range data values. The GCT and PAL-1 color table formats, described in Sects. B.5 and B.8, respectively, provide for special color values which can be assigned to such outliers.)

B.2. ACT Color Tables

The .act filename extension stands for Adobe Color Table and indicates a type of color file which may be used in graphics programs from Adobe Systems. Often an ACT file defines 256 color values, but the format allows for defining less. Figure B.3 shows a 256-color ACT grayscale color table.

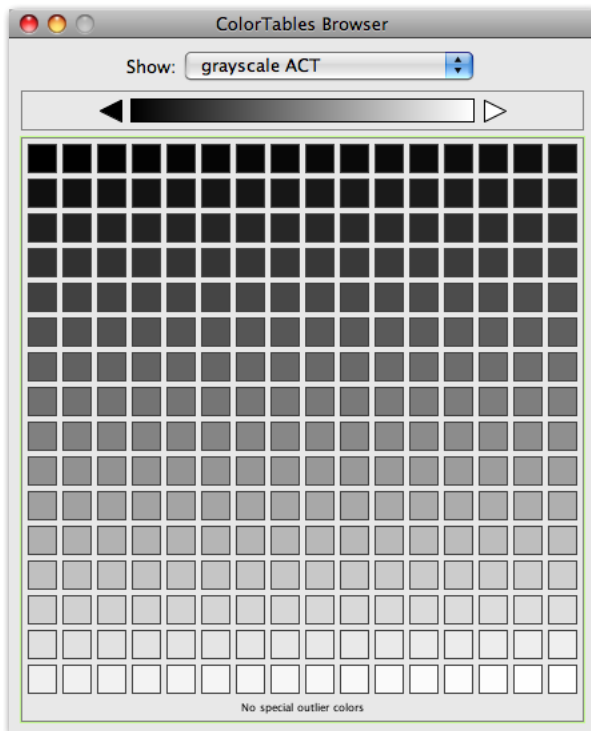


Figure B.3

An ACT file is in binary form and is at least 768 bytes long. If it is only 768 bytes, then it specifies exactly 256 colors. If it is longer (probably 772 bytes), then byte 769 specifies how many colors there are. Panoply ignores bytes 770-772 if they are present.

The first 768 bytes of an ACT file are arranged as 256 triplets, each of which specifies the RGB value of a color. Bytes 1-3 define the first color, with byte 1 specifying its red value, byte 2 the green value and byte 3 the blue value. Bytes 4-6 define the second color, and so on until the correct number of colors is reached. Any remaining bytes are ignored.

B.3. CPT Color Files

The .cpt extension identifies a text file describing a type of color table most commonly used in the Generic Mapping Tools (GMT) software package*. Unlike all the preceding types of color files, a CPT file does not define its color as a number of discrete “bins” or indices. Instead, a CPT file 1) specifies a range of data values over which its color values apply, and 2) defines color bands or gradients for one or more sub-ranges within that range. Thus, a CPT file could indicate in five lines a set of five discrete colors or it might in just one line define a simple gradient. It could also define a mix of solid colors and gradients.

* See <http://gmt.soest.hawaii.edu/>.

The formatting of each line of a CPT file varies, dependent on whether the file uses the RGB, HSV, or CMYK color space, and also whether it uses any shortcut labels, such as using the word `red` rather than numerical values which define the color red. See section 4.15 of the GMT Technical Reference* for details. Panoply is able to read many of these variations but not all of them.

When interpreting a CPT file, Panoply converts the information into 500 discrete bins, as is shown by Fig. B.4 for a color table useful for presenting topographical relief information.

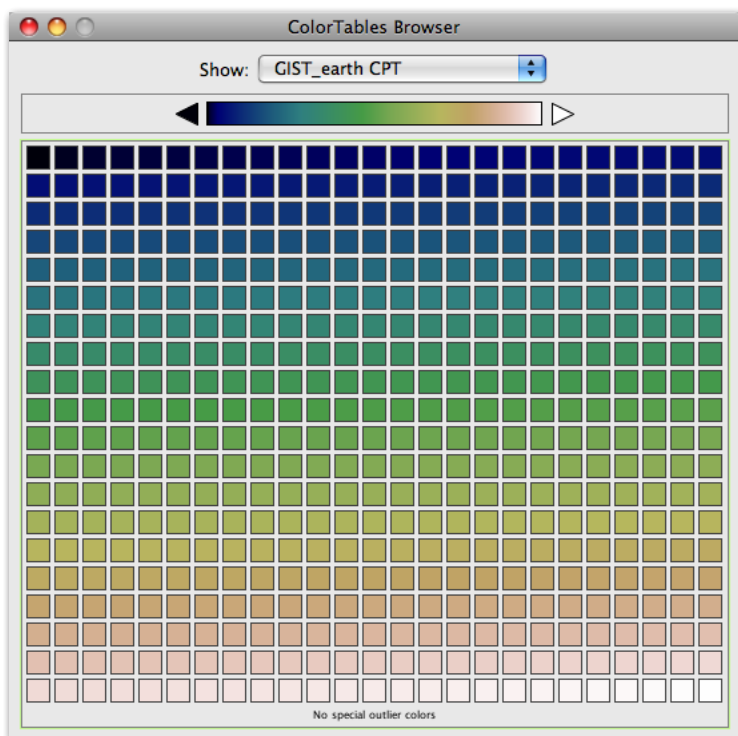


Figure B.4

Further, Panoply only looks at a CPT file's defined minimum and maximum data values when it initially determines the distribution of colors within the 500 bins. These extremes are ignored thereafter; the minimum and maximum values of a plot colorbar will be those chosen by the user and not those given within any CPT color table which might be applied.

Although CPT files do not define colors for data values outside the colorbar scale range, they optionally may specify a fill color to use where there are missing data. At present, Panoply ignores this color even where defined and instead uses the fill color selected by the user to represent such areas.

If the color tables included with Panoply do not suit your needs, you may find that the extensive collection of CPT color tables on the cpt-city website at <http://www.cpt-city.org.uk/> includes some that you can use.

B.4. CWC Color Tables

The `.cwc` extension identifies a binary file format which was used in Apple Computer's AppleWorks application, also known as ClarisWorks. This type of file specifies a color table with exactly 256 color values.

No examples of CWC color tables are included in the Panoply application package. Support for this format is maintained for users of legacy color tables included with older versions of Panoply.

* Located at http://gmt.soest.hawaii.edu/gmt/doc/html/GMT_Docs/GMT_Docs.html.

B.5. GCT Color Tables

A GCT color table, denoted by a `.gct` file extension, is a variant of the ACT file format (described in Sect. B.2) which allows for specification of out-of-range color values. The abbreviation stands for “GISS Color Table.” This format is not used by any plotting or graphics program other than Panoply.

Like an ACT color table, the first 768 bytes of a GCT file describe as many as 256 colors, with byte 769 indicating how many of those colors are actually used. Where the GCT file format differs from the ACT format is that it subsequently uses bytes 771-776 to indicate the outlier colors (byte 770 is not used). Bytes 771, 772 and 773 respectively specify the red, green, and blue values of the color to be applied to plot data values less than the scale minimum, while bytes 774, 775 and 776 do likewise for the greater-than-maximum color.

B.6. GPL Color Tables

The `.gpl` filename extension indicates a text file describing a type of color table used by the GIMP image editing program. The first line of the file is an identifier and must state “GIMP Palette.” It may be followed by comment lines, each beginning with a `#` sign. After that follow the lines specifying space-delimited RGB values for the colors in the table. The number of colors defined may vary.

B.7. PAL Color Tables

The `.pal` extension stands for “palette” and indicates a simple but fairly common color table format saved in binary form. Such a file specifies exactly 256 colors. Figure B.5 shows a 256-color PAL color table. It is a smooth gradient version of the 20-color ACT color table shown in Fig. B.2.

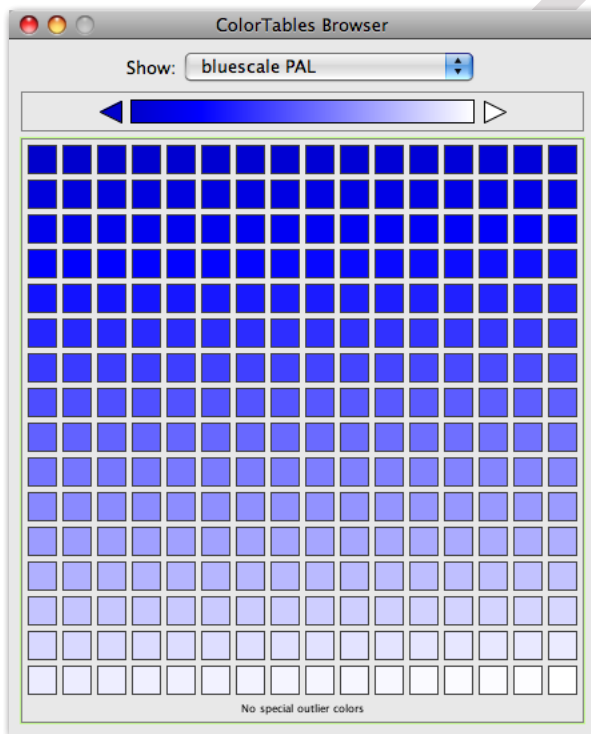


Figure B.5

Although a PAL file is 768 bytes long, the bytes define color values in a different ordering than they do in an ACT color table. In a PAL file, the first 256 bytes specify the red values, the middle 256 bytes specify green values, and the final 256 bytes the blue values. This means that if a data value is identified by Panoply as corresponding to the first color value then the matching RGB color value is found by examining bytes 1, 257, and 513 of the file.

B.8. PAL-1 Color Tables

A PAL-1 color table is a special case of a PAL color table. It is identified by a `.pal` filename extension — that's a numeral 1 at the end and not a lowercase L — so that Panoply can distinguish between them. Structurally, a PAL-1 file is the same as a PAL file, but Panoply treats the first and 256th colors in a PAL-1 file as being special and only uses colors 2-255 to draw the scale itself, i.e., a 254-color scale. The first color value in the file is treated as corresponding to all values in the plot less than the specified minimum; the 256th color is applied for all values greater than the maximum.

Figure B.6 shows the chief example of a PAL-1 color table, the default Panoply color table. This is a “rainbow” color table which runs from blue to yellow to red.

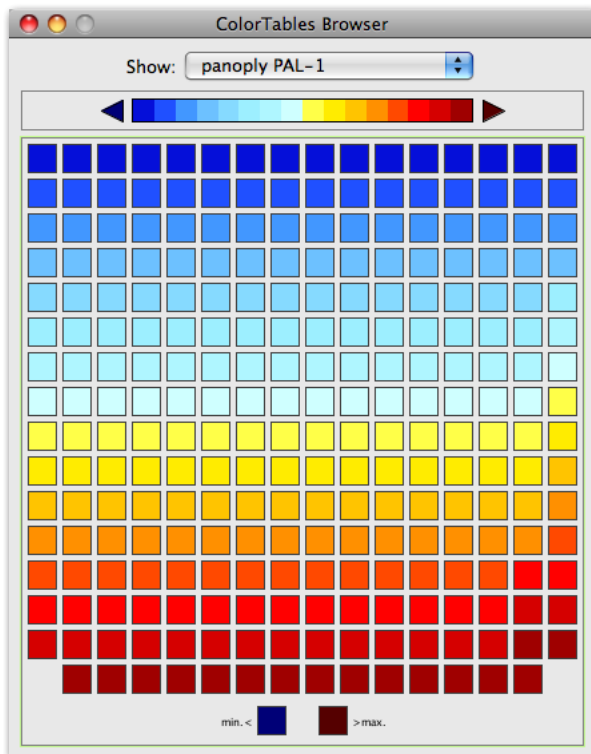


Figure B.6

Because it has a limited number of colors over that range, just 16, this default color table would seem to be a good candidate for the ACT color table format. However, the default color table also includes two special outlier colors (dark blue is specified for values less than the scale minimum and dark red for values greater than the maximum), and so this scheme requires the PAL-1 format.

Figure B.7 shows how this color table might appear when used in a scale for temperature anomaly data.

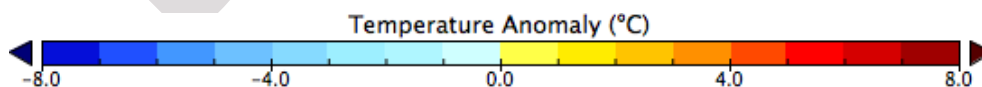


Figure B.7

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